1 stepped pressure equilibrium code : fe00aa

Contents

1.1 outline

1. Calculates finite element functions, and their derivatives, on radial sub-sub-grid. The quantities calculated are the $\varphi_{l,p}$ for $l = 0, 1$ and $p =$ 0,`Nofe` which are stored in array `felr(0:1,0:Nofe,0:1,1:Nj)` (which is allocated in `readin`).

2. This routine is only called once, from `xspech`.

3. Should check that $\varphi_{1,p}(x) = (-1)^p \varphi_{0,p}(1-x)$ is satisfied.

4. Radial quadrature is performed using Gaussian quadrature. The resolution of the approximation is controlled by `Iquad`, and the weights and abscissae are returned by NAG routine `D01BCF`. At present, only `itype=0` (Gauss-Legrendre) and `a=0`, `b=1`, `c=0` and `d=0` are supplied as input to `D01BCF`.

5. The array `felr(0:1,0:Nofe,0:1,1:Iquad)` is constructed as follows:

   (a) the first argument is the left-right index: `felr(0,p,0,j)`$= \varphi_{0,p}(x_j)$ and `felr(1,p,0,j)`$= \varphi_{1,p}(x_j)$;

   (b) the second argument is the order of the basis function:

   (c) the third argument is the derivative: `felr(0,p,1,j)`$= \varphi'_{L,p}(x_j)$;

   (d) and the fourth argument indicates the radial sub-sub-grid index.

6. Note that the derivatives **with respect to x** are returned, where $x = (s - s_{l,i-1})/\Delta s_l$ and $\Delta s_l = (s_{l,i} - s_{l,i-1})$. The radial scaling factor Δs_l needs to be included elsewhere.

7. The radial basis functions used are:

   - `Nofe=0`: linear basis functions;
   - `Nofe=1`: cubic basis functions;

$$\begin{array}{lrlrlrlrl}
\varphi_{0,0} &=& 2 & x^3 & - & 3 & x^2 & + & 1 \\
\varphi_{0,1} &=& & x^3 & - & 2 & x^2 & + & x \\
\varphi_{1,0} &=& -2 & x^3 & + & 3 & x^2 & & \\
\varphi_{1,1} &=& & x^3 & - & & x^2 & &
\end{array} \tag{1}$$

   - `Nofe=2`: quintic basis function;

$$\begin{array}{lrlrlrlrlrlrl}
\varphi_{L,0} &=& -6 & x^5 & + & 15 & x^4 & - & 10 & x^3 & & & + 1 \\
\varphi_{L,1} &=& -3 & x^5 & + & 8 & x^4 & - & 6 & x^3 & & + & x \\
\varphi_{L,2} &=& -1/2 & x^5 & + & 3/2 & x^4 & - & 3/2 & x^3 & + 1/2 & x^2 & \\
\varphi_{R,0} &=& 6 & x^5 & - & 15 & x^4 & + & 10 & x^3 & & & \\
\varphi_{R,0} &=& -3 & x^5 & + & 7 & x^4 & - & 4 & x^3 & & & \\
\varphi_{R,0} &=& 1/2 & x^5 & - & & x^4 & + & 1/2 & x^3 & & &
\end{array} \tag{2}$$

   - `Nofe=3`: septemtic basis function;

$$\begin{array}{lrlrlrlrlrlrlrlrl}
\varphi_{0,0} &=& 20 & x^7 & - & 70 & x^6 & + & 84 & x^5 & - & 35 & x^4 & & & & & & + 1 \\
\varphi_{0,1} &=& 10 & x^7 & - & 36 & x^6 & + & 45 & x^5 & - & 20 & x^4 & & & & + & 1 & x \\
\varphi_{0,2} &=& 2 & x^7 & - & 15/2 & x^6 & + & 10 & x^5 & - & 5 & x^4 & & & + 1/2 & x^2 & & \\
\varphi_{0,3} &=& 1/6 & x^7 & - & 2/3 & x^6 & + & 1 & x^5 & - & 2/3 & x^4 & + 1/6 & x^3 & & & & \\
\varphi_{1,0} &=& -20 & x^7 & + & 70 & x^6 & - & 84 & x^5 & + & 35 & x^4 & & & & & & \\
\varphi_{1,1} &=& 10 & x^7 & - & 34 & x^6 & + & 39 & x^5 & - & 15 & x^4 & & & & & & \\
\varphi_{1,2} &=& -2 & x^7 & + & 13/2 & x^6 & - & 7 & x^5 & + & 5/2 & x^4 & & & & & & \\
\varphi_{1,3} &=& 1/6 & x^7 & - & 1/2 & x^6 & + & 1/2 & x^5 & - & 1/6 & x^4 & & & & & &
\end{array} \tag{3}$$

   - otherwise there is an error;

fe00aa.h last modified on 2012-09-21 ;